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Two proxies from one biomineral: AAR geochronology and isotopic palaeoaridity indices from ostrich eggshell in archaeological sites

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Eggshells of the ostrich, *Struthio camelus*, are abundant in archeological and paleontological sites in Africa. Fossil ostrich eggshell preserves both intra-crystalline peptides and carbonate carbon and oxygen isotope composition, providing the means to determine both an amino acid racemisation (AAR) age and ambient conditions. Unlike most herbivorous mammals, the ostrich's main dietary criterion is tenderness, so they select plants from all three photosynthetic pathways, and since they rely almost exclusively on plant water, carbonate $^{18}\text{O}/^{16}\text{O}$ reflects primarily evapotranspiration rates and hence humidity. Here we report results applied to archeological sites in South Africa. Chronostratigraphy is independently constrained for Elands Bay Cave (EBC) by radiocarbon, and for the older site of Pinnacle Point 5-6 by OSL and Th/U, providing robust tests for the AAR geochronology from multiple amino acids. At Wonderwerk Cave the chronology has large gaps beyond the Holocene, although biostratigraphy, cosmogenic burial ages and magnetic reversals indicate Early Pleistocene ages for the lower levels. The results show that AAR is able to identify heated samples, and to distinguish between sub-stages of OIS stages 5, 4, 3 and 1, while at Wonderwerk the results provide greater resolution for the previously undated Middle Pleistocene levels. At Pinnacle Point a muted aridification trend is observed from OIS5 to 4, while at EBC the results indicate significant humidity shifts from about 14 ka through the Holocene. The Wonderwerk OES isotope record is far more variable throughout, with significant arid episodes and a longterm aridification trend up to and including the Holocene. NERC (NE/G004625/1) *Building a better egg timer*; Oxford University Boise Fund; German Academic Exchange programme (DAAD); PP research - NSF (BCS-0524087, BCS-1138073), Hyde Family Foundation, and Institute of Human Origins.